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UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE BOARD OF PATENT APPEALS
AND INTERFERENCES

Ex parte SHIHE FAN,
STEVEN CHARLES GROSSNICKLE, MARLIES RISE,
STEPHEN M. ATTREE, and RAYMUND FOLK

Appeal 2009-014231
Application 10/726,574
Technology Center 1600

Decided: April 01, 2010

Before TONI R. SCHEINER, LORA M. GREEN, and
RICHARD M. LEBOVITZ, *Administrative Patent Judges.*

SCHEINER, *Administrative Patent Judge.*

DECISION ON APPEAL

This is an appeal under 35 U.S.C. § 134 from the final rejection of claims 1-10, 12-32, and 45, directed to a method of producing autotrophic plants from conifer somatic embryos in *ex vitro* conditions. The claims have been rejected on the ground of obviousness. We have jurisdiction under 35 U.S.C. § 6(b).

STATEMENT OF THE CASE

"For zygotic embryos in natural seed, germination is supported by stored nutrients within the endosperm (in angiosperms) or megagametophyte (in gymnosperms)" (Spec. 2: 8-9). But somatic embryos "lack[ ] the nutritive tissues and the protective seed coat that a zygotic seed possesses" (*id.* at 3: 7-8), so "nutrients needed to support germination [and early growth] must be supplied by a nutrient medium during somatic embryo culture" (*id.* at 2: 12-13 and 3: 10). "An object of the present invention is to provide a method enabling the production of complete, independent, autotrophic plants from conifer somatic embryos . . . in conventional nursery conditions (i.e., non-sterile, *ex vitro* conditions)" (*id.* at 5: 18-20).

The claims are directed to a method of sowing a heterotrophic somatic plant embryo or germinant of a conifer species by contacting the heterotrophic somatic embryo or germinant with a nutrient medium, and exposing it to conditions effective for conversion to an autotrophic seedling, all under *ex vitro* non-sterile conditions.

Claims 1 and 19 are representative of the subject matter on appeal:

1. A method of sowing a heterotrophic somatic plant embryo or germinant of a conifer species to facilitate growth of the embryo or germinant into an autotrophic seedling, which method comprises the following steps:

providing a nutrient medium comprising particles of a solid component contained within a flowable component containing water and a carbohydrate nutrient for the embryo or germinant, said flowable component being selected from the group consisting of a fluid and a semi-solid, and said solid particles being present at a concentration up to 10% (w/v);

dispensing a quantity of the nutrient medium onto a surface of a porous solid growth substrate for the somatic plant embryo or germinant and contacting said plant embryo or germinant with said nutrient medium; and

exposing said embryo or germinant to environmental conditions effective for growth into an autotrophic seedling;

wherein at least said dispensing, contacting and exposing steps are carried out *ex vitro* in non-sterile conditions; and

wherein said particles forming said solid component are adapted to remain in contact with said embryo or germinant after said flowable component undergoes dissipation in said environmental conditions, thereby providing continuing physical support for said embryo or germinant after said dissipation.

19. The method of claim 1, wherein said flowable component of said nutrient medium is a semi-solid comprising a flowable gel containing said carbohydrate in dissolved form.

The Examiner rejected the claims as follows:

- Claims 1-10, 12-20, 23, 24, 27, 29-32, and 45 under 35 U.S.C. § 103(a) as unpatentable over Fan[1] and Pierik.[2]

- Claims 21, 22, 25, 26, and 28 under 35 U.S.C. § 103(a) as unpatentable over Fan, Pierik, Gupta,[3] and Tremblay.[4]

We reverse.

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[1] US 6,444,467 B1, issued September 3, 2002 to Fan et al.
[2] R.L.M. PIERIK, IN VITRO CULTURE OF HIGHER PLANTS 54-56 (1997).
[3] US 5,563,061, issued October 8, 1996 to Gupta.
[4] Laurence Tremblay & Francine M. Tremblay, *Maturation of black spruce somatic embryos: Sucrose hydrolysis and resulting osmotic pressure of the medium*, 42 Plant Cell Tissue and Organ Culture 39-46 (1995).

OBVIOUSNESS: Fan and Pierik

Issue

Has the Examiner established that the combined teachings of Fan and Pierik would have suggested growing a heterotrophic somatic plant embryo or germinant on or in a nutrient medium dispensed on the surface of a porous solid growth substrate, wherein the nutrient medium comprises a flowable component containing water, a carbohydrate nutrient, and up to 10% solid particles, wherein the solid particles in the nutrient medium remain in contact with the embryo or germinant and provide continuous physical support after the flowable component of the nutrient medium has dissipated?

Findings of Fact

FF1 Claim 1 requires, in part, dispensing a nutrient medium (comprising a fluid or semi-solid flowable component containing water, a carbohydrate nutrient, and solid particles) onto the surface of a porous solid growth substrate, and contacting a heterotrophic somatic plant embryo or germinant with the nutrient medium. The solid particles in the nutrient medium are "present at a concentration up to 10% (w/v)." While there is no lower limit specified for the solid particles, they cannot be completely absent, because the claim requires that particles from the nutrient medium remain in contact with the embryo or germinant and provide continuing physical support after the flowable component dissipates.

FF2 "'Heterotrophic' refers to the stage of plant development when the photosynthetic organelles, related enzymes and biochemical pathways are . . . not completely functional or capable of converting light energy, atmospheric carbon dioxide and water into the prerequisite carbohydrates

(e.g., glucose) necessary to sustain further plant growth and development" (Spec. 18: 1-6).

FF3 "'Autotrophic' refers to the stage of plant development in which the photosynethetic organelles, related enzymes and biochemical pathways are completely functional and capable of converting light energy, atmospheric carbon dioxide and water into the prerequisite carbohydrates (e.g., glucose) necessary to sustain further plant growth and development" (Spec. 16: 1-5).

FF4 "By definition, heterotrophic plants are not able to survive and grow under normal soil conditions" (Spec. 18: 9-10), because they "still require an exogenous supply of carbon and energy resources in the growth medium such as sucrose, to sustain normal growth and development" (*id.* at 18: 6-8). This is in contrast to autotrophic plants, which "are able to survive and grow under normal soil conditions" (Spec. 16: 5-6).

FF5 "'Conversion' refers to the transition from a heterotrophic stage of plant development to an autotrophic stage of plant development. The term 'converted' as applied to an embryo or germinant means an embryo or germinant that has undergone conversion and is autotrophic." (Spec. 16: 18-21).

FF6 "'Germinant' refers to a somatic embryo that has been pre-germinated but not converted" (Spec. 17: 27).

FF7 "'Pre-germination' refers to a process of contacting a mature somatic embryo with medium for any period of time until onset of autotrophic development" (Spec. 19: 6-7).

FF8 "'Somatic embryo" refers to a plant embryo formed in vitro from vegetative (somatic) cells by mitotic division of cells" (Spec. 19: 24-

25), and 'Somatic embryogenesis' is the process of initiation and development of embryos *in vitro* from somatic cells and tissues" (Spec. 19: 29-30).

FF9 Fan discloses "a multi-step process for ex vitro sowing and germination of plant somatic embryos using conventional horticultural equipment and facilities" (Fan, col. 7, ll. 22-25). Fan broadly outlines the process in eleven steps. Steps 1 and 2 concern pre-germination, and optional steps 3-6 concern conditioning the pre-germinated germinants obtained in steps 1 and 2, and placing them into dormancy (Fan, col. 7, ll. 38-59). Steps 7-11 concern sowing the still heterotrophic pre-germinated plant somatic embryos into nursery containers for growth (i.e., conversion) into autotrophic seedlings.

FF10 Steps 7-11 of Fan's process are as follows:

> 7. Sowing the pre-germinated plant somatic embryos into nursery containers containing a three-phase substrate, said three phases comprising solids, liquids and air.
>
> 8. Placing the nursery containers . . . into a conventional plant propagation environment . . . to enable and facilitate the re-germination of the somatic embryos and their further development into seedlings.
>
> 9. Supplying an aerosol . . . containing the necessary carbohydrate compounds required to initiate and sustain the re-germination processes of the somatic embryos.
>
> 10. Supplying . . . an aerosol and/or a liquid suspension and/or a liquid solution, the micro- and macro- mineral elements required to sustain the re-germination of somatic embryos and their subsequent development into seedlings.

> 11. Adjusting . . . the ambient light intensity and diurnal photoperiod, temperature and atmospheric humidity to maintain the development of re-germinated somatic embryos into fully functional seedlings.

(Fan, col. 7. l. 60 to col. 8, l. 17.)

FF11 "[S]owing and propagation of pre-germinated somatic embryos [i.e., step 7] can be practiced with a wide variety of non-sterilized growing substrates commonly used in conventional plant propagation" (Fan, col. 9, ll. 13-16). Examples include mixtures of peat, vermiculite, perlite, dolomite lime, microelements, and a wetting agent; and commercially formulated soilless mixtures such as PRO-MIX-G® or PRO-MIX-PGX® (*id.* at col. 9, ll. 16-63). After the pre-germinated somatic embryos are sown onto the surface of the substrate, they can be covered with a thin layer of the same substrate, or with a different material, such as coconut husk fibers (*id.* at col. 9, l. 64 to col. 10, l. 5).

FF12 As discussed above, exogenous nutrients may be applied to the embryos or germinants as aerosols (FF10, steps 9 and 10) with "conventional misting and/or fogging equipment" (Fan, col. 10, l. 50). "An alternative . . . means of supplying exogenous nutrients to pre-germinated somatic embryos sown onto three-phase growing media within nursery containers is to irrigate or 'drench' the media with nutrient solutions . . . just before the embryos are sown in the three-phase growing media" (Fan, col. 11, ll. 6-12), i.e., just before step 7.

FF13 Pierik teaches that agar "can be used as a gelling agent in most nutrient media" when culturing higher plants in vitro (Pierik 55).

Principles of Law

Analyzing obviousness under 35 U.S.C. § 103 requires "a searching comparison of the claimed invention - including all its limitations - with the teaching of the prior art." *In re Ochiai*, 71 F.3d 1565, 1572 (Fed. Cir. 1995).

"[A] patent composed of several elements is not proved obvious merely by demonstrating that each of its elements was, independently, known in the prior art. . . . [I]t can be important to identify a reason that would have prompted a person of ordinary skill in the relevant field to combine the elements in the way the claimed new invention does." *KSR Int'l Co. v. Teleflex Inc.*, 550 U.S. 398, 418 (2007). While the Court has endorsed "an expansive and flexible approach" to the obviousness analysis (*id.* at 415), "[w]e must still be careful not to allow hindsight reconstruction of references to reach the claimed invention without any explanation as to how or why the references would be combined to produce the claimed invention." *Innogenetics, N.V. v. Abbott Labs.*, 512 F.3d 1363, 1374 n.3 (Fed. Cir. 2008).

Analysis

The Examiner finds that Fan discloses

> [A] method of sowing naked heterotrophic . . . somatic embryos on a nutrient medium comprising 1-9% of sucrose (column 4, line 10), The solid components are but not restricted to vermiculite, perlite, peat (pulp of wood containing alpha cellulose) coconut husk fibres (which are flexible fibbers) and the like (biologically inert) (column 8, lines 50-51). The solid components (discontinuous surface) contain sufficient liquid germination medium to enable the formation of a thin capillary layer or film of germination medium around the somatic embryos (column 8, lines 52-54). The somatic embryos are sown on the discontinuous surface (column 8, line 49). The embryos are exposed to environmental conditions effective for

> growth (column 7, lines 63-67). The sowing and germination steps are carried out *ex-vitro* in non-sterile conditions (column 7, lines 22-25, and abstract, lines 14-17). Fan et al. teach Pro-Mix-PGX medium (porous solid growth substrate) (column 10, line 4). Fan et al. teach producing seedlings (young autotrophic plants) from the heterotrophic embryos (abstract).

(Ans. 3.)

The Examiner acknowledges that Fan "fail[s] to teach the content of solids in the medium to a maximum of 10%" (Ans. 3), but concludes that "[t]he percentage of solids in the medium is a clear result of effective parameters that a person of ordinary skill in the art would routinely optimize" (*id.* at 4).

Appellants contend that Fan discloses a multi-step process to produce seedlings from somatic embryos:

> The first main step involves "pre-germination" followed by placing the embryos into a state of physical dormancy . . . The second main step involves placing the pre-germinated embryos . . . on or within the surface of a three-phase substrate (e.g. soil or soil-substitute - the phases being solid liquid and gas), and then transferring the substrate containing the pre-germinated embryos into an environmentally-controlled plant growth environment and applying water and/or nutrient solutions at regular intervals (e.g. by misting with micro-droplets or by drenching . . .)

(App. Br. 16).

Appellants contend that "[t]he claims of the present application . . . are confined to a final step of converting embryos or germinants into autotrophic seedlings" (App. Br. 14), and "have nothing to do with 'pre-germination', i.e. . . . [Fan's] first step, . . . therefore, any disclosure in Fan et

al. that relates to the pre-germination step is irrelevant to the present invention" (*id.* at 16-17).

Appellants contend that "the overall teaching of Fan et al. has been distorted" because the Examiner's rejection "rel[ies] heavily on statements . . . that describe the pre-germination step rather than the step of sowing for growth into autotrophic seedlings" (App. Br. 19). Appellants acknowledge that Fan "do[es] describe a step of sowing for growth into seedlings, but this step does not bear any resemblance to the steps required in the broad claims of the present application" (*id.*).

We agree with Appellants that most of the Examiner's discussion of Fan focuses on pre-germination steps (i.e., steps 1 and 2 of Fan), which are not performed on or in the materials used in subsequent steps in which the pre-germinated heterotrophic somatic plant embryo or germinant is grown into an autotrophic seedling (FF10). However, the Examiner also relies on Fan's disclosure of sowing harvested pre-germinated somatic plant embryos into nursery containers and placing them in a plant propagation environment to facilitate re-germination of the somatic embryos and their development into autotrophic seedlings (Fan, col. 7, l. 60 to col. 8, l. 2). It is these steps (i.e., steps 7-11 (FF10)) which must be compared with the claimed method.

We agree with Appellants that steps 7-11 of Fan's method don't teach or suggest the claimed method. The claimed method requires the step of providing a fluid or semi-solid flowable nutrient solution that includes solid particles which remain in contact with, and physically support the growing embryos or germinants during their conversion to autotrophic seedlings after the fluid or semi-solid portion of the nutrient medium has dissipated. However, the Examiner has not established that Fan's nutrient medium,

which is applied to the porous solid growth medium by aerosol in steps 9 and 10, or by drenching prior to step 7 (FF10, FF12), contains any solid particles, much less particles capable of persisting and providing structural support to the embryo once the fluid portion of the nutrient medium has dissipated. Therefore, it is not, as the Examiner asserts, simply a matter of optimizing the percentage of solids in the nutrient medium, especially as the Examiner has not identified a reason to put solid particles into the nutrient medium to begin with.

Conclusions of Law

The Examiner has not established that the combined teachings of Fan and Pierik would have suggested growing a heterotrophic somatic plant embryo or germinant on or in a nutrient medium dispensed on the surface of a porous solid growth substrate, wherein the nutrient medium comprises a flowable component containing water, a carbohydrate nutrient, and up to 10% solid particles, wherein the solid particles in the nutrient medium remain in contact with the embryo or germinant and provide continuous physical support after the flowable component of the nutrient medium has dissipated.

The rejection of claims 1-10, 12-20, 23, 24, 27, 29-32, and 45 as unpatentable over Fan and Pierik is reversed.

OBVIOUSNESS: Fan, Pierik, Gupta, and Tremblay

The Examiner rejected claims 21, 22, 25, 26, and 28 as unpatentable over Fan, Pierik, Gupta, and Trembley. Gupta and Tremblay were cited to meet the limitations of these dependent claims, but do not remedy the underlying deficiency in the Examiner's proposed combination of Fan and

Pierik. Thus, the rejection of claims 21, 22, 25, 26, and 28 as unpatentable over Fan, Pierik, Gupta, and Tremblay is reversed as well.

SUMMARY

- The rejection of claims 1-10, 12-20, 23, 24, 27, 29-32, and 45 under 35 U.S.C. § 103(a) as unpatentable over Fan and Pierik is reversed.
- The rejection of claims 21, 22, 25, 26, and 28 under 35 U.S.C. § 103(a) as unpatentable over Fan, Pierik, Gupta, and Tremblay is reversed.

REVERSED

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